

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington D.C. 20554

In the Matter of)	
)	
The Development of Operational, Technical)	
and Spectrum Requirements for Meeting)	WT Docket No. 96-86
Federal, State and Local Public Safety)	
Communication Requirements Through)	
the Year 2010)	

**COMMENTS OF MOTOROLA TO THE
SEVENTH NOTICE OF PROPOSED RULEMAKING**

Steve B. Sharkey
Director, Spectrum and Standards Strategy
1350 I Street, NW, Suite 400
Washington, DC 20005-3305
(202) 371-6953

Robert D. Kubik, Ph. D.
Manager, Spectrum and Regulatory Policy
1350 I Street, NW, Suite 400
Washington, DC 20005-3305
202 371-6940

May 27, 2005

Table of Contents

Summary	i
I. Motorola Comments on the 7 th NPRM Proposals.	2
A. TIA-PRS Proposals.....	2
1. ACP Values for 50, 100 and 150 kHz Mobile and Base Station Transmitters.	2
2. Relaxing ACP Limits for Base Stations in Paired Receive Band.	3
3. Corresponding Changes to ACP Limits for Guard Band Transmitters.	6
B. Secondary Fixed Operations and Digital Base Station ID.....	6
C. Access Spectrum Proposals.	8
D. Nortel/EADS Proposal.....	9
E. NCC Recommendations.....	9
1. Wideband Interoperability Channel Standard.....	9
2. Wideband Radio Channel Requirement.....	10
3. Section 90.548.....	11
4. Encryption Standard.....	12
5. 700 MHz System Design Parameters.	12
F. Rule Clarifications.	13
II. Conclusion.	13
Appendix A: Example of System Isolation Requirements	A1

Summary

Motorola submits these comments in response to the Seventh Notice of Proposed Rulemaking that considers technical changes to the rules applicable to 700 MHz public safety operations regulated under Part 90 of the FCC's rules. Certain of these changes would also affect the rules applicable to 700 MHz Guard Band Service authorized under Part 27 of the rules.

As further described herein, Motorola recommends that the FCC:

- Adopt the TIA-recommended Adjacent Channel Power (ACP) tables for 50 kHz and 100 kHz channel bandwidths.
- Require vendors that configure multiple transmitters/carriers within a single channel bandwidth to certify the multiple transmitters together at the appropriate ACP channel bandwidth.
- Reduce the ACP limit in the paired receive band from -100 dBc to -85 dBc.
- Adopt corresponding changes to the ACP limits for 700 MHz Guard Band operations.
- Allow 700 MHz licensees to conduct secondary fixed operations and to transmit the required station identification in the digital mode.
- Eliminate the "in-band" emissions restrictions on 700 MHz Guard Band operations and provide greater flexibility in the deployment of transmitters of different bandwidths in the Guard Band spectrum.
- Reject the recommendation of Nortel and EADS to amend the first ACP offset value for 12.5 kHz bandwidth transmitters from 9.375 kHz to 9.55 kHz and to modify the measurement bandwidth for this first offset from 6.25 kHz to 5.9 kHz.
- Adopt TIA-902 (SAM) as the 700 MHz wideband interoperability standard and require that all wideband radios be capable of operating on all the wideband interoperability channels using the TIA-902 (SAM) standard.
- Modify its rules to reference updated ANSI/TIA/EIA documents.
- Adopt the Advanced Encryption Standard as the existing encryption standard for the 700 MHz interoperability channels
- Clarify that the low power channels available under Section 90.531(b)(4) are exempt from the mandatory trunking requirements.

Motorola commends the FCC's diligence in ensuring that the rules applicable to 700 MHz operations adequately balance licensee flexibility with interference protection and interoperability and urges the Commission to expeditiously implement its proposals consistent with the recommendations contained herein.

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington D.C. 20554

In the Matter of)	
)	
The Development of Operational, Technical)	
and Spectrum Requirements for Meeting)	WT Docket No. 96-86
Federal, State and Local Public Safety)	
Communication Requirements Through)	
the Year 2010)	

**COMMENTS OF MOTOROLA TO THE
SEVENTH NOTICE OF PROPOSED RULEMAKING**

Motorola, Inc. (Motorola) hereby submits these comments in response to the Seventh Notice of Proposed Rulemaking in the above-captioned proceeding.¹ In this phase of this proceeding, the Commission is considering certain technical changes to the rules applicable to 700 MHz public safety operations regulated under Subpart R of Part 90 of the FCC's rules. Certain of these changes would also affect the rules applicable to 700 MHz Guard Band Service authorized under Part 27 of the rules.

Motorola commends the FCC's diligence in ensuring that the rules applicable to 700 MHz operations adequately balance licensee flexibility with interference protection and interoperability. Motorola urges the Commission to expeditiously implement its proposals consistent with the recommendations contained herein.

¹ *The Development of Operational, Technical and Spectrum Requirements for Meeting Federal, State and Local Public Safety Communication Requirements Through the Year 2010, WT Docket No. 96-86, Fifth Memorandum Opinion And Order, Sixth Report And Order, and Seventh Notice Of Proposed Rulemaking, 20 FCC Rcd 831 (2005) (hereinafter 7th NPRM).*

I. Motorola Comments on the 7th NPRM Proposals.

A. TIA-PRS Proposals

1. ACP Values for 50, 100 and 150 kHz Mobile and Base Station Transmitters.

Section 90.543 of the Commission's Rules currently contains adjacent channel power (ACP) limits for wideband base and mobile transmitters operating with 150 kHz channel bandwidth.² The Private Radio Section of the Telecommunications Industry Association (TIA-PRS) has recommended that the FCC add tables that would describe ACP emission limits for transmitters operating with 50 kHz and 100 kHz bandwidths. The 7th NPRM seeks comments on the wideband transmitter tables suggested by TIA-PRS, tentatively concluding that the inclusion of such tables would offer manufacturers greater flexibility in designing wideband equipment with bandwidths other than 150 kHz and would dovetail with the Commission's policy of allowing licensees to aggregate wideband channels from 50 kHz building blocks.³

Motorola supports the adoption of the TIA-PRS recommended tables for 50 kHz and 100 kHz bandwidths. As noted by the Commission, Section 90.531(c) of the Commission's Rules specifies that the wideband segment of the public safety 700 MHz allocation is comprised of 50 kHz channels with licensees able to aggregate multiple 50 kHz blocks to form greater bandwidths. It stands to reason that the rules should provide ACP tables for 50 kHz and 100 kHz bandwidths so that the licensing policies correspond with the adjacent channel interference protection standards. This will facilitate more intensive and efficient "packing" of the wideband channels.

² 47 C.F.R. § 90.543 of the Commission's Rules.

³ 7th NPRM at ¶ 37.

The Commission should consider, however, the licensing and equipment authorization implications of deploying multiple 50 kHz transmitters within a single 150 kHz channel. A 50 kHz wide transmitter conceivably can be coupled with one or two other 50 kHz transmitters and deployed in a 100 kHz or a 150 kHz channel, respectively. If such a configuration is routinely made available by manufacturers, Motorola believes that the system should be authorized as a whole and tested for compliance with the 100 kHz or 150 kHz ACP limitations, as appropriate, to ensure that any intermodulation effects are considered in the testing process. While users should have flexibility in the deployment of wideband technologies, Motorola believes that the FCC should clarify that use of 50 kHz wide channels require the use of transmitters certified under the 50 kHz ACP table and meet 50 kHz data efficiency standard. Similarly, use of 100 kHz wide channels would require the use of transmitters certified using the 100 kHz ACP table and meet the 100 kHz data efficiency standard while use of 150 kHz wide channels require the use of transmitters certified under the 150 kHz ACP table and meet 150 kHz data efficiency standard. Vendors should be permitted to place multiple transmitters/carriers within a single channel but the multiple transmitters, simultaneously operating together, must be certified for the appropriate ACP channel bandwidths.⁴ This certification requirement would apply to both base and mobile transmitters.

2. Relaxing ACP Limits for Base Stations in Paired Receive Band.

In addition to adding ACP tables for 50 kHz and 100 kHz wideband transmissions, TIA-PRS also recommended that the Commission reduce the ACP requirement in the paired receive band from -100 dBc to -85 dBc, for both wideband and narrowband base station transmitters

⁴ Certification of aggregated transmitters should only be permitted in cases where the channel use is contiguous. For example, vendors should not be permitted to certify equipment using the 100 kHz or 150 kHz requirements if the equipment only includes two 50 kHz transmitters using the top and bottom portions of a 150 kHz channel.

arguing that external filtering at the base station transmitter will easily offset this change.⁵ The FCC tentatively concluded to reject this recommendation out of concern that this will impose additional cost burdens on public safety licensees to acquire such additional filtering.⁶

Motorola supports reducing the ACP limit from -100 dBc to -85 dBc in the paired receive band and urges the Commission to reconsider its tentative conclusion. Adoption of this recommendation will actually reduce public safety costs, not the opposite as the Commission fears. Reducing the limit will provide licensees additional flexibility in how to meet system requirements and would, in general, require fewer filters to implement a system. There should be no concern that systems would not meet or exceed -100 dBc, because attenuation of the transmitter noise well below this level is necessary to avoid interference within a licensee's own system.

TIA previously submitted information to the Commission that provided an analysis of transmitter noise attenuation requirements in the paired receiver band.⁷ The analysis showed that the base station transmitter ACP requirement of -100 dBc was insufficient to guarantee that a receiver in the paired frequency band would not be desensitized by the transmitter noise.⁸ By necessity, system designers must account for this fact in order to achieve the expected system performance. An example demonstrating the ACP requirements for a typical system is included in Appendix A. This example clearly demonstrates the need for system designers to suppress emissions to below -100 dBc. Reducing the ACP limit to -85 dBc will provide system designers

⁵ 7th NPRM at ¶ 38.

⁶ *Id.* at ¶ 39.

⁷ See Letter from Wayne Leland, Chairman, Private Radio Section, TIA to Ms. Magalie Roman Salas, Secretary, FCC, WT Docket No. 96-86, submitted July 16, 2002.

⁸ *Id.* at Annex 2.

with greater options for achieving the real-world suppression requirement in a more cost-effective manner.

Maintaining the -100 dBc ACP requirement will require that a transmitter post filter be integrated as a part of each transmitter for the purpose of meeting the FCC requirement. Additional external filtering will also be required to meet the real world system design requirements. As an alternative, the proposed TIA ACP limit of -85 dBc will allow for a single filter at the output of a transmitter combining network or some combination of distributed filtering that is optimized from an implementation and cost consideration. Therefore, for a 5 or 10 channel transmitter combining network, the necessary filtering requirements can be supplied by one filter versus individual filters at the output of each individual transmitter plus additional external filtering. In Motorola's opinion, compliance with the existing -100 dBc ACP specification will be a more costly implementation and require more physical space due to the need for individual transmit filters.

In summary, the critical system design consideration is that the transmitter noise does not desensitize the receiver. Since neither the existing FCC limit of -100 dBc nor the TIA proposed limit of -85 dBc is sufficient to guarantee that receiver desensitization does not occur, the TIA proposed ACP limit will allow greater flexibility in the system design and cost tradeoffs. For these reasons, Motorola recommends that the Commission adopt the TIA recommended limit for paired receive band ACP.

3. Corresponding Changes to ACP Limits for Guard Band Transmitters.

The TIA-PRS proposed that its recommended changes to Section 90.543(a) should also apply to Section 27.53(d) applicable to the 700 MHz Guard Band Service.⁹ Noting that it based the ACP limits contained in Section 27.53(d) on the same limits contained in Section 90.543(a) to ensure that equipment operating in the guard bands provided the same level of interference protection as equipment operating in the 700 MHz Public Safety band, the Commission tentatively concluded to adopt this recommendation.¹⁰

Motorola supports the Commission's tentative conclusion. The additional flexibility and clarity that TIA's recommendations offer will be equally applicable in the 700 MHz Guard Band Service.

B. Secondary Fixed Operations and Digital Base Station ID.

The 7th *NPRM* seeks comments on the TIA-PRS recommendation to apply the existing rules for 800 MHz secondary fixed operations and station identification to 700 MHz operations.¹¹ The effect of these recommendations would be to allow 700 MHz public safety licensees to conduct fixed ancillary signaling and data transmissions on a secondary basis under specified conditions and to transmit their required station identifications in the digital mode.

⁹ 7th *NPRM* at ¶ 40.

¹⁰ *Id.*

¹¹ 7th *NPRM* at ¶ 41. *See also*, 47 C.F.R. §§ 90.637 (addressing operational fixed stations in the 800 MHz band) and 90.647(c) (addressing station identification of digital base stations in the 800 MHz band).

Motorola supports the adoption of these proposals. With regard to secondary fixed operations, the regional planning process and the operational restrictions currently codified in Section 90.637 provides adequate protections to address any concerns over interference to the primary mobile services.

With regard to the station identification requirement, Motorola has urged the Commission to expeditiously address this apparent oversight in the 700 MHz public safety rules for some time. The Commission has previously determined that allowing licensees operating primarily in the digital mode to transmit the required station identification in the digital mode as well serves the public interest.¹² Failure to apply that same policy in the 700 MHz Public Safety band would require licensees to purchase and operate equipment that includes an analog mode or Morse Code capability, which would unnecessarily raise the cost of equipment.

Motorola expects that the Commission will receive nothing but unqualified support for this proposed modification of the station identification rules. If so, the FCC should act as quickly as possible to adopt this rule change. If it appears that other issues in this proceeding prove to be more contentious and cannot be concluded quickly, the Commission should consider segregating this issue from the more controversial items in this proceeding. The quick issuance of a Report and Order will obviate the need for manufacturers and licensees to design work-

¹² See *Amendment of Parts 2 and 90 of the Commission's Rules to Provide for the Use of 200 Channels Outside the Designated Filing Areas in the 896-901 MHz and 935-940 MHz Bands Allotted to the Specialized Mobile Radio Pool*, PR Docket No. 89-553, *Report and Order*, 8 FCC Rcd 1469, ¶¶ 48-49 (1993). There, the FCC's recognized that it is "disruptive to the operation of a station that normally transmits digital signals to break every 30 minutes to transmit a voice or Morse Code identification" and concluded that "[i]n the case of stations that are licensed on an exclusive basis and are, therefore, unlikely to cause co-channel interference, there is considerably less need for the Commission to be able to monitor for a station's identifier than in the case of shared channels." This finding is independent of the frequency band of operation. Therefore, the only reason that the 700 MHz public safety band was not included in the application of digital station identification policy is that it was not yet allocated for exclusive land mobile uses.

around solutions for the immediate future that will add costs for public safety licensees and administrative workloads on the Commission.

C. Access Spectrum Proposals.

The 7th *NPRM* seeks comment on a request filed by Access Spectrum, LLC (Access Spectrum) that the Commission make clear that out-of-band emission requirements for the 700 MHz Guard Band apply only at the boundaries of a commercial licensee’s authorized allocation.¹³ The Commission also seeks comment on Access Spectrum’s recommendation that the ACP requirements for the 700 MHz Guard Band contained in Section 27.53(d) should be easily scalable to correspond to any authorized bandwidth.¹⁴

Motorola agrees that the ACP requirements should not unnecessarily interfere with the ability of 700 MHz Guard Band licensees from aggregating its authorized spectrum into broader bandwidths provided public safety services are adequately protected. The FCC did not adopt a channeling plan for the guard band allocations. As such, it is inconsistent to impose “in-band” emissions restrictions on operations within the guard bands.

While introduction of ACP tables for 50 kHz and 100 kHz wideband transmitters will provide additional flexibility for guard band operations, Motorola also understands the desire for additional flexibility to accommodate transmitters of different bandwidths as well. For example, it is easy to envision fixed operations within the guard band allocations with bandwidths of 200 kHz, 500 kHz or even 1 MHz. Because this spectrum is licensed and managed by the band manager it is appropriate to provide this additional flexibility provided the protection to adjacent licensees is not impacted.

¹³ 7th *NPRM* at ¶ 42.

¹⁴ *Id.* at ¶ 43.

D. Nortel/EADS Proposal.

The 7th *NPRM* seeks comment on the recommendation of Nortel and EADS who propose that the Commission amend Section 90.543(a) and adjust the first offset value for 12.5 kHz bandwidth transmitters from 9.375 kHz to 9.55 kHz.¹⁵ In addition, Nortel/EADS also recommend that the Commission modify the measurement bandwidth for this first offset from 6.25 kHz to 5.9 kHz.¹⁶

Motorola disagrees with the recommendations of Nortel and EADS and urges the Commission to reject these proposals. The ACP values and measurement procedures were developed within the TIA, a certified industry standards body, where industry consensus is required. The relaxation sought by Nortel/EADS, was considered by the TIA and rejected by a majority of the participants because it reduces adjacent channel protection.

E. NCC Recommendations.

1. Wideband Interoperability Channel Standard.

The 7th *NPRM* notes that it originally tasked the National Coordinating Committee (NCC) to develop the interoperability standards for both wideband and narrowband interoperability channels. In 2000, the NCC recommended Project 25, Phase I as the standard for narrowband interoperability but stated that it required additional work on a wideband standard. In July of 2003, the TIA – working in cooperation with the NCC – recommended that the FCC adopt Scalable Adaptive Modulation (identified by TIA as the TIA-902 (SAM) suite of standards) as the wideband interoperability standard. The NCC subsequently recommended that

¹⁵ 7th *NPRM* at ¶ 46.

¹⁶ *Id.*

the Commission adopt TIA-902 (SAM) as the wideband interoperability standard for 700 MHz.¹⁷ The 7th NPRM tentatively concludes to adopt this standard and seeks comment on this decision.

Motorola supports the Commission's recommendation to adopt TIA-902 (SAM) as the 700 MHz wideband interoperability standard. We agree with the Commission's conclusion that a single standard must be selected to ensure equipment compatibility and to achieve interoperability on the 700 MHz wideband interoperability channels. Having a common interoperability standard is critical to effective public safety communications when communications among various emergency responders is necessary. As noted by the Commission, TIA-902 (SAM) is a published industry standard and was developed with industry consensus. Furthermore, multiple equipment vendors supported TIA-902 (SAM) during the NCC wideband interoperability standard review, adoption and recommendation process, resulting in the NCC recommendation to the FCC to adopt this standard. Motorola recommends that the Commission expeditiously adopt TIA-902 (SAM) as the wideband interoperability standard.

2. Wideband Radio Channel Requirement.

The 7th NPRM tentatively concludes that 700 MHz wideband radios must have the capability to operate on the wideband interoperability channels under the TIA-902 (SAM) standard and seeks comment on this proposal.¹⁸ NCC offered an exception to this proposed rule: special-purpose equipment where the modem is integral to the special-purpose device (*i.e.*, a

¹⁷ See letter from Kathy Wallman, Chair, National Coordinating Committee to Michael Powell, Chairman, Federal Communications Commission, WT Docket No. 96-86, (July 25, 2003).

¹⁸ 7th NPRM at ¶ 53.

non-detachable component in a common enclosure or case).¹⁹ The Commission tentatively concludes to adopt these recommendations and seeks comment on these issues.

Motorola supports the Commission's proposal. Requiring all wideband radios in the 700 MHz band to be capable of operating on the interoperability channels utilizing the TIA-902 (SAM) standard is critical to enabling interoperability among emergency responders and would meet the intent of having interoperability channels.²⁰

3. Section 90.548.

The NCC recommends that the Commission amend Section 90.548 to reflect updated ANSI/TIA/EIA documents that describe the narrowband interoperability standards.²¹ The FCC seeks public comment on its tentative conclusion to reference the versions of the ANSI documents. Motorola supports this action and notes that the updated versions of the standard are backward compatible with the old revisions. Therefore, equipment certified under the old standard should be grandfathered, as they would be compatible with devices built to the new standard.

¹⁹ *Id.*

²⁰ Motorola supports the limited exception for specialized self-contained single purpose devices set forth in the NCC recommendations.

²¹ *Id.* at ¶ 54.

4. Encryption Standard.

The FCC seeks comment on the NCC's recommendation to modify the existing encryption standard for the 700 MHz interoperability channels as the former standard has been compromised.²² The NCC recommends that the Commission require the use of the Advanced Encryption Standard (AES), which was approved by TIA on June 13, 2002.

Motorola supports this recommendation and the Commission's tentative conclusion. The AES standard was adopted by an industry consensus and has now been tested successfully in the field. Motorola knows of no alternative solution that could be quickly implemented into existing equipment designs.

5. 700 MHz System Design Parameters.

The NCC identifies a number of recommended system design criteria, *e.g.*, minimum usable signal levels and conformance with TIA Technical Services Bulletin No. 88 when considering co-channel and adjacent channel assignments, that system designers should consider. The NCC does not ask the Commission to codify these requirements but the 7th *NPRM* seeks comment on whether the FCC should promote use of recommended design parameters for the public safety 700 MHz band.

Motorola agrees that the NCC recommended design criteria should not be codified, as there are too many exceptions to these rules. However, the Commission should generally support designing systems using best Engineering practices that have been developed for the NCC and NPSTC. Rather than including these references in the C.F.R., perhaps the FCC could find an appropriate location on its web site, which is widely available to a broad audience.

²² *Id.* at 56.

F. Rule Clarifications.

The 7th NPRM notes that Section 90.537 makes no mention of whether the low power channels available under Section 90.531(b)(4) are subject to or exempt from the trunking requirements described above. The Commission proposes to clarify this ambiguity by clearly exempting these channels from the requirement. Motorola supports this decision, as requiring the use of trunking will limit the flexibility and utility of these channels.

II. Conclusion.

Motorola urges the FCC to expeditiously adopt its proposed changes to the technical rules for 700 MHz public safety and guard band operations consistent with the recommendations contained herein. This action will provide clarity and flexibility in the design and manufacture of 700 MHz equipment that is urgently needed to address urgent Homeland Security and mission critical applications.

Respectfully Submitted,

/s/ Steve B. Sharkey

Steve B. Sharkey
Director, Spectrum and Standards Strategy
1350 I Street, NW, Suite 400
Washington, DC 20005-3305
(202) 371-6953

/s/ Robert D. Kubik

Robert D. Kubik, Ph. D.
Manager, Spectrum and Regulatory Policy
1350 I Street, NW, Suite 400
Washington, DC 20005-3305
202 371-6940

May 27, 2005

Appendix A

Example of System Isolation Requirements

Consider a typical public safety system consisting of 10 or more base stations at a single site. Assume 10 base transmitters are active during busy periods. Base transmit output power is 100 watts. Such systems will employ low-loss cavity transmit combiners to connect 5 to 10 transmitters into a single antenna. Transmit combiner insertion loss plus attenuation into the paired receive band 18 to 30 MHz away will typically be 40 to 45 dB. Base receive installation will consist of a single receive antenna feeding a multi-receiver distribution network (consisting of multicoupler, amplifier, filter, line, attenuator, etc) having 5 to 10 dB of net gain between antenna output and receiver input. Typical receivers will have a sensitivity of -116 dBm plus 1 to 3 dB of margin and a signal to noise ratio (S/N) of 7 dB (Project 25).

In order to provide stable coverage, this typical system should limit the total desensitization of the licensee's own receivers from multiple active transmitters to 1 dB or less. To accomplish this, the transmitter noise level into each receiver from each transmitter must be at least 16 dB below the receiver's internal noise floor.¹ For a roof top antenna site, the net transmitter noise level delivered to the licensee's own base transmit antenna must be less than -160 dBc assuming a 35 dB horizontal (near field) coupling loss between transmit and receive

¹ To realize 1 dB of receiver noise floor increase due to the active transmitters' noise the transmitter noise contributions must be 6 dB below the receiver internal noise floor. By way of example, consider a noise power that has a normalized value of 1 or 0 dB. Add another uncorrelated normalized noise power of 0.25 or -6 dB to the first noise power. The result is a normalized noise power of 1.25. When represented in decibel notation, the total noise power is $10 \log(1.25) = 1$ dB. Further consider the case where multiple transmitters are active. For this example, it is assumed that 10 transmitters will be active, which causes the multiple transmitter noise contributions to be 10 dB greater than a single transmitter. Therefore, it is necessary that the noise contribution from one transmitter be 16 dB (6 dB + 10 dB) below the receiver noise floor to realize no more than 1 dB increase in the receiver noise floor or, equivalently, no more than 1 dB of receiver desensitization. The following equation is used to find the target transmitter noise level: Target TX Noise level = RX Sensitivity – S/No – 16 dB

antennas.² For a tower antenna site, the net transmitter noise level must be less than -150 dBc assuming 50 dB antenna coupling loss.³ Since the transmit combiner attenuation into receive band is only about 45 dB, even with a base transmitter -100 dBc ACP requirement, additional filtering will be required in the transmit antenna network to prevent receiver desensitization (5 dB for tower sites; 15 dB for rooftop sites). A typical transmit band pass, receive band reject filter placed after the low loss combiner would provide over 35 dB of attenuation into the receive band. Using this combiner technique, a -85 dBc ACP transmitter would meet this minimum protection criterion within the licensee's own system⁴. Other antenna site combiner methods would have similar results, requiring additional filtering after the transmitter, regardless if the ACP is set at -85 dBc or -100 dBc.

² For rooftop location with 10 ft horizontal antenna separation, calculating backwards from receiver input to transmit antenna input: -116 dBm sensitivity – 1 dB margin – 7 dB S/No – 16 dB multi-transmitter “desense” protection - 5 dB gain of rooftop receive distribution network + 35 dB antenna coupling loss = -110 dBm maximum transmitter noise level into transmit antenna. For a typical 100 watt transmitter: +50 dBm transmitter power output – (-110 dBm) target level = 160 dBc minimum transmitter noise attenuation.

³ For tower site with 6 ft vertical antenna separation: -116 dBm sensitivity – 1 dB margin – 7 dB S/No – 16 dB multi-transmitter desense protection - 10 dB gain of tower receive distribution network + 50 dB antenna coupling loss = -100 dBm maximum transmitter noise level into transmit antenna. For a typical 100 watt transmitter: +50 dBm transmitter power output – (-100 dBm) target level = 150 dBc minimum transmitter noise attenuation.

⁴ For typical 100 watt transmitter with -85 dBc ACP into paired receive band: +50 dBm transmit power output - 85 dBc transmitter noise suppression = -35 dBm noise level out of transmitter. Level required into base transmit antenna = -35 dBm noise level – 4 dB combiner insertion loss – 40 dB combiner noise suppression – 1 dB external filter insertion loss – 35 dB external filter suppression – 1 dB line loss (rooftop site) = -116 dBm. This noise level is less than -110 dBm target level for rooftop site and -100 dBm level for tower site.